



# **Mold and Moisture Control in Schools: Potential Health Effects and Safe Clean-Up Practices**

**November 19, 2013**



Indoor Air Quality (IAQ)

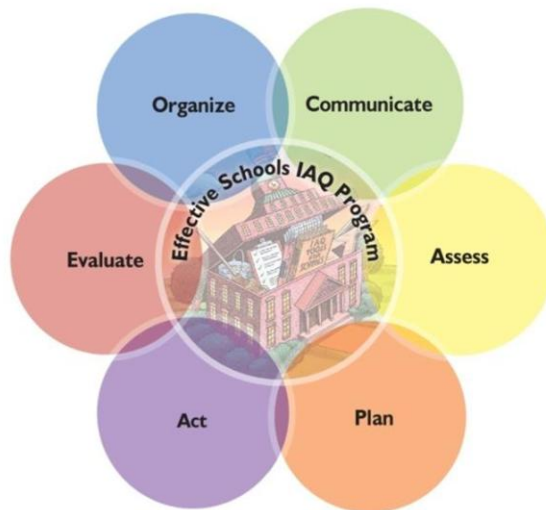
**Tools to Help you Effectively Manage IAQ Issues**

# IAQ Tools for Schools



Indoor Air Quality (IAQ)

# The Framework for Effective School IAQ Management



Indoor Air Quality (IAQ)

# The Framework for Effective School IAQ Management: Six Key Drivers

## ORGANIZE

- Develop Systematic Approach
- Identify Existing Assets
- Design SOPs
- Empower an IAQ Leader
- Build an Effective Team
- Create Champions
- Secure Senior Buy-In

Organize

## COMMUNICATE

- Share Your Goals
- Make IAQ Meaningful
- Be Transparent & Inclusive
- Communicate Results (ROI)

Communicate

## EVALUATE

- Solicit Feedback
- Capture ROI

Evaluate

## ASSESS

- Walk the Grounds
- Listen to Occupants
- Use Technology
- Determine a Baseline
- Keep Customers Satisfied
- Identify and Prevent Risks

Assess

## ACT

- Educate Staff About IAQ to Change Behavior
- Train Occupants to Address IAQ Risks
- Address the Source of Problems

Act

## PLAN

- Prioritize Actions
- Put Goals in Writing
- Start Small
- Work in Stages
- Plan for the Future

Plan

## ACTION KIT

- HVAC
- Moisture/Mold
- IPM
- Cleaning & Maintenance
- Materials Selection
- Source Control



## The Framework for Effective School IAQ Management: **Six Technical Solutions**



## The Framework for Effective School IAQ Management: Six Technical Solutions

### Quality HVAC

- Inspect HVAC systems regularly
- Establish a maintenance plan
- Change filters regularly and ensure condensate pans are draining
- Provide outdoor air ventilation according to ASHRAE Standard or local code
- Clean air supply diffusers, return registers, and outside air intakes
- Keep unit ventilators clear of books, papers, and other items

### Control of Moisture/Mold

- Conduct routine moisture inspections
- Establish mold prevention and remediation plan
- Maintain indoor humidity levels between 30% and 60%
- Address moisture problems promptly
- Dry wet areas within 24-48 hours

### Strong Integrated Pest Management (IPM)

- Inspect and monitor for pests
- Establish an IPM plan
- Use spot treatments and baits
- Communicate with occupants prior to pesticide use
- Mark indoor and outdoor areas treated with pesticides



### Effective Cleaning & Maintenance

- Conduct routine inspections of school environment
- Develop a preventative maintenance plan
- Train cleaning/maintenance staff on protocols
- Ensure material safety data sheets (MSDS) are available to staff
- Clean and remove dust with damp cloth
- Vacuum using high-efficiency filters

### Smart Materials Selection

- Maintain products inventory
- Develop low-emitting products purchasing and use policies
- Use only formaldehyde-free materials
- Use only low-toxicity and low-emitting paint
- Select products based on product rating systems
- Use least toxic cleaners possible (only those approved by the district)

### Aggressive Source Control

- Conduct regular building walkthrough inspections
- Test for radon; mitigate if necessary
- Implement a hazardous materials plan (use, label, storage and disposal)
- Establish a school chemical management and inventory plan
- Implement Smoke-Free policies
- Establish an anti-idling school bus policy
- Use walk-off mats at building entrances
- Conduct pollutant-releasing activities when school is unoccupied

Indoor Air Quality (IAQ)



## **Mold Control is Moisture Control: Beyond the Basics**

**Steven M. Caulfield, P.E., CIH**  
**Turner Building Science & Design, LLC**  
[www.turnerbuildingscience.com](http://www.turnerbuildingscience.com)

Copyright Turner Building Science & Design, LLC 2009

## **Class Overview**

This class introduces the basic causes of indoor environmental quality (IEQ) problems and begins to develop a method of diagnosis and solution. Students will gain an understanding of the dynamic components of indoor environmental quality in relation to source control, occupant sensitivity and ventilation. Emphasis will be placed on communications with building occupants for reliable investigations without aggravating existing issues.

## **Agenda**

1. Indoor Environmental Quality Overview
2. Fundamentals of Indoor Environmental Quality
3. Preventing IEQ Problems
4. Elements of an IEQ Program
5. Effective Communication



# MOLD GROWTH BASICS



Copyright Turner Building Science & Design, LLC 2013

## **Mold (fungi) Amplification is Limited by Moisture**

- Liquid moisture needed to initiate growth
- 55 - 85°F preferred (ACGIH)



# BUILDING MOISTURE



Copyright Turner Building Science & Design, LLC 2013

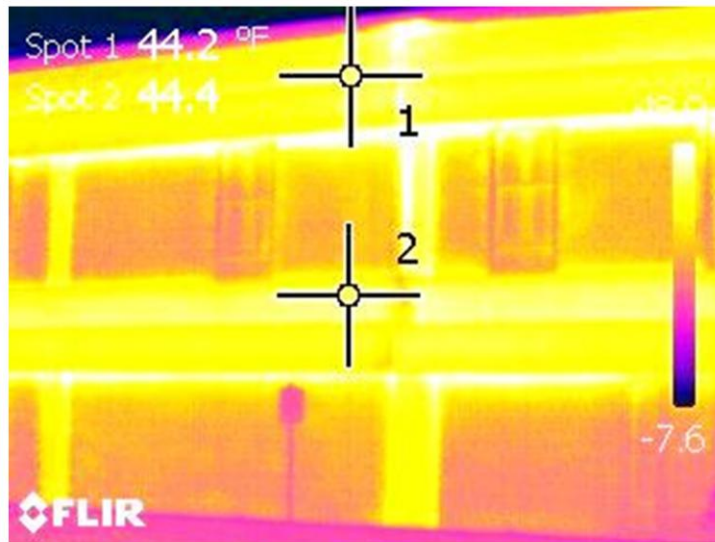
## **Buildings Get Wet From:**

- **Site Issues, Wicking Of Water**
- **Climate Moisture and Condensation**
- **Wind Driven Rain and Plumbing Leaks**
- **Occasionally: Occupant Activities**

# Three Main Concepts for Today

- Air leakage leads to condensation
- Air Conditioning vs. Dehumidification
- Flashing

# AIR LEAKAGE



Copyright Turner Building Science &  
Design, LLC 2013

# Moisture Rules

- Moisture flow is from warm to cold
- Moisture moves from more to less
- Air carries moisture from high pressure areas to low pressure areas
- Gravity pulls water down
- Water wicks up
- Drainage is critical

Courtesy Camroden Associates

Copyright Turner  
Building Science &  
Design, LLC 2009

---

---

---

---

---

---

---

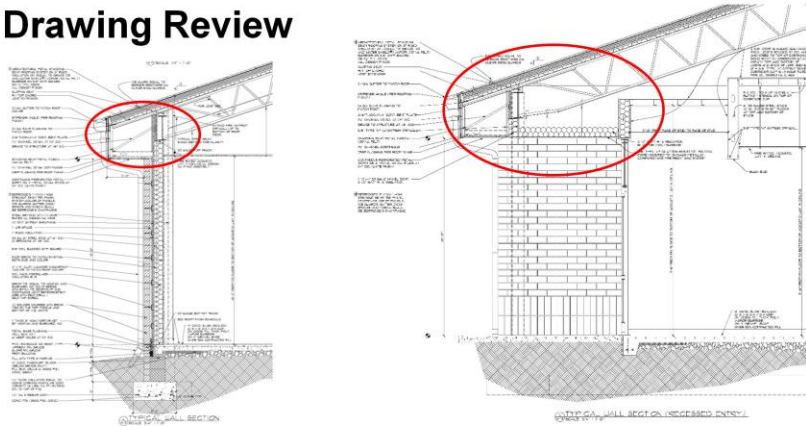
---

---

---

# Where Does All The Air Go?

- Drawing Review





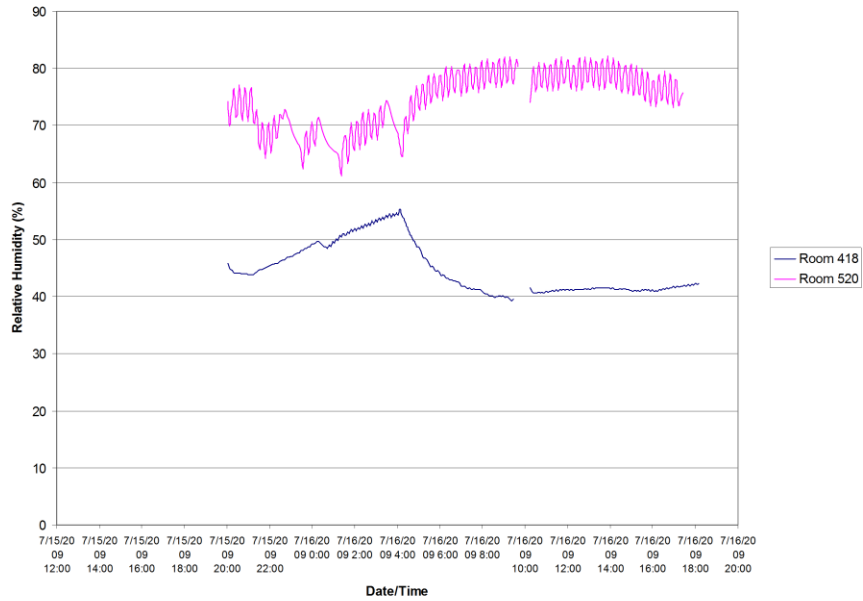
# Where Does All The Air Go?



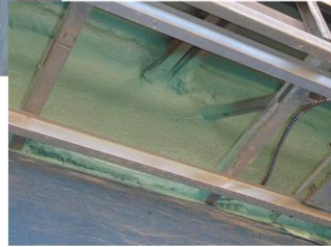
Copyright Turner Building Science & Design, LLC 2013

17

Relative Humidity Measurements



# How Do We Fix It?



## Another Example

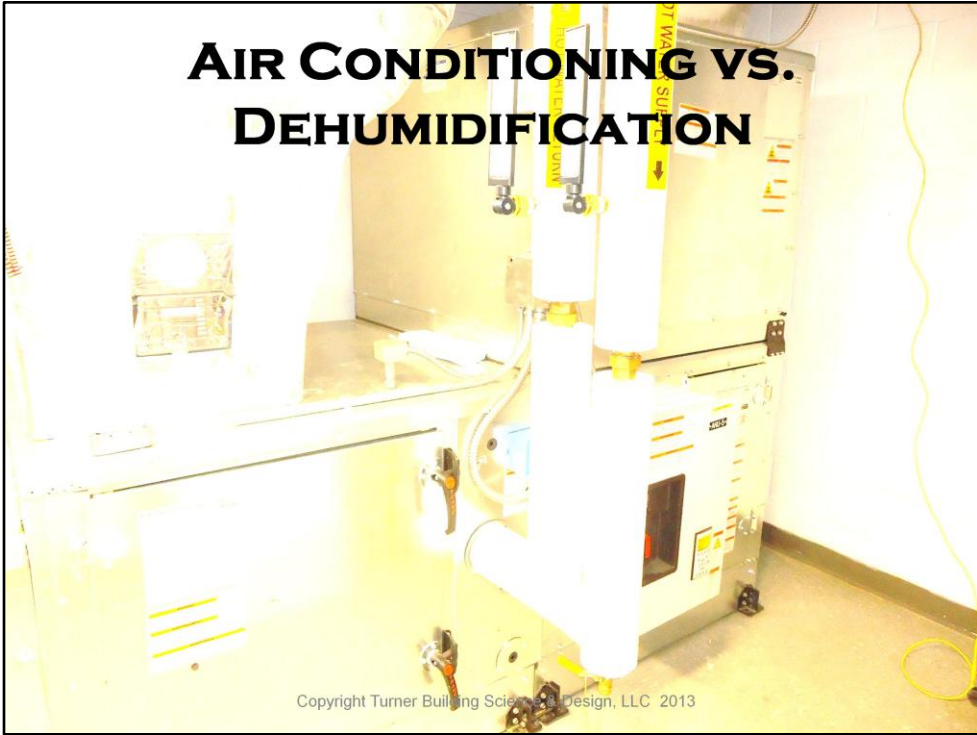


Copyright Turner Building Science & Design, LLC 2013





# AIR CONDITIONING VS. DEHUMIDIFICATION



Copyright Turner Building Science Design, LLC 2013

# Air Conditioning

- Typically only runs cooling coil when indoor temperature is above setpoint
- If running for short periods of time - water condensed on coil will evaporate into the air
- This is referred to as an “over-sized” air conditioning unit
- Space will cool without removing any moisture
- Results in raising relative humidity



# The Heat Pump Problem

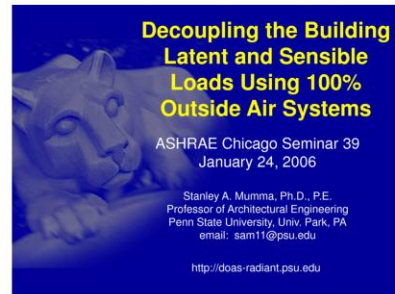
- In northern climates, heat pumps are sized for heating load
- Cooling load is often lower than heating load requirement
- This results in an “over-sized” heat pump unit



Copyright Turner Building Science & Design, LLC 2013

# The Solution

- DOAS – Dedicated Outdoor Air Supply
- Intended to treat all outdoor air to dry, neutral temperature conditions
- Heat pump, fan coils, ductless split systems can simply heat or cool the air without dehumidification



# FLASHING



Copyright Turner Building Science & Design, LLC 2013

# Flashing

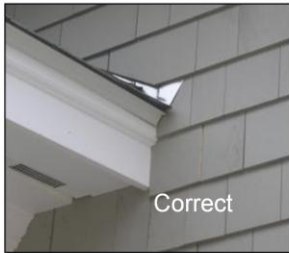
- ❖ Must flash all penetrations to be continuous & avoid wall wetting
- ❖ Intentional holes should not be straight through wall, water will follow air.

## Poor flashing details



- ❖ Incomplete coverage of skirtboard allows moisture penetration
- ❖ Note proximity of grade to wooden skirt

# Incorrect flashing?



- ❖ Failure to properly weave step flashing into horizontal cladding
- ❖ Board sheathing soaked and insect-ridden...



© 2013 Turner Building Science & Design, LLC



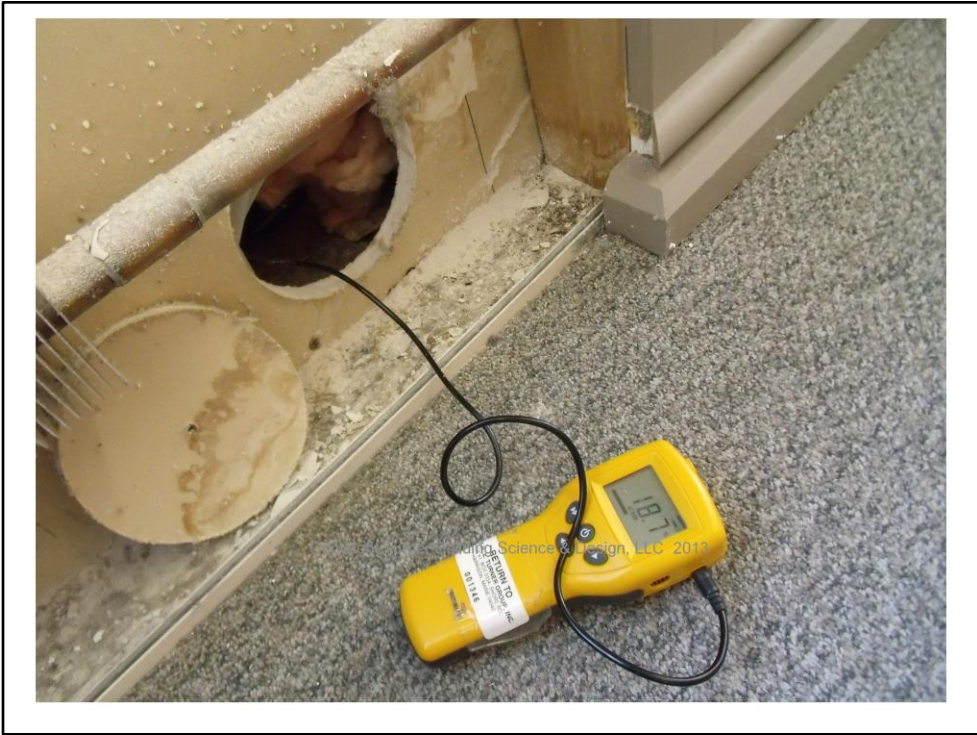




Copyright Turner Building Science & Design, LLC - 2013



Copyright Turner Building Science & Design, LLC



# Summary

- **Moisture control is mold control**
- Reduce air leakage to limit condensation potential
- Design and use cooling equipment appropriately
- Use flashing at openings to direct water outdoors

# DOUBLE TROUBLE: Mold & Moisture

---



62,000 students

7,700 staff

62 facilities

6 new being built

# Katy Independent School District

Suburban school district that encompasses 181 square miles in southeast Texas.

- 62,000 Students
- 7,700 Staff
- 62 Facilities



Part of the school district is located in Fort Bend County the 4th fastest growing county in the nation. In 2001, one of our schools was shut down and all the students relocated during the year due to concerns of mold. It was that event that initiated the implementation of the EPA Tools for Schools Program and hiring an IAQ Coordinator

## Indoor Mold Food Sources

---

- Drywall
- Wood
- Carpets
- Ceiling tiles
- Books
- Paper
- Furniture
- Organic



Mold can grow on virtually any organic material as long as moisture and oxygen are present.

Construction material, building design, occupant behavior and maintenance/operations practiced must be considered in the Mold and Moisture Plan.

# Prevent Mold: Clean

---

- Dry area
- Remove moldy items
- Remove wet items
- Clean mold off all hard surfaces



Cleaning is important to maintain a healthy school. If food and spills are not removed, mold will grow. Cleaning prior to unoccupied time periods or before storage will help prevent mold growth. Therefore training of the custodial staff is necessary.





Let's look at how we considered building design and construction material in our mold action plan.

We have 13 elementary schools in the same footprint design. What you see here is the backside of a restroom pod.

# Plumbing

---



Inside these walls are plumbing lines, Johnny rings, trap primers, joints and fittings. There are numerous water intrusion opportunities.

## What Fiberglass Insulation Can Do



In the past, fiberglass has been used for sound proofing walls. When the fiberglass is pushed down into stud tracks any water and moisture will migrate. Sheetrock will also, but not like the insulation. The two together are a sure moisture problem. On this picture you can see that the sheetrock is dry from the ceiling down. You can also see that there are no plumbing lines in this wall system. The water traveled in the track from the mop sink just a couple of feet on the left.

# **Tramex Moisture Meter**

---



Realizing that these pods have high probability of leaks, we implemented quarterly inspections with a tramex moisture meter. The readings are plotted on a floor plan and saved in our work order system.

# Moisture Travels

---



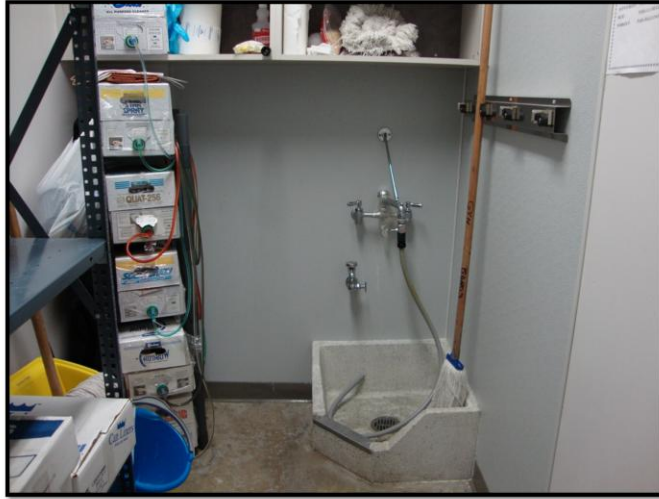
We realize that moisture travels from wet to dry and to the weakest or lowest point. Sometimes we perform destructive tests. This water came from a mop sink.

# BEFORE



Both plumbing and occupant behavior played a part in the leak.

# AFTER



We reconstructed with FRP board and tightly sealed seams. Custodial training and assistance on hanging mops and water hoses assisted in prevention of wet walls.

## Look for Visual Signs



Rust and separation of wall paper is a sign of water that clues us to investigate for moisture.



## **Evidence of Exterior Water Intrusion**



The leaching of minerals through brick signals an opening in the building envelop.



Wet ceiling should be removed and the leak investigated as soon as possible. We have written guidance for removing ceiling tile for a healthy indoor environment and the safety of our employees.

## Caulking at Sinks

---



During the TfS walk-thru inspection, the caulking around sinks is examined for failures. Sometime caulking is the only thing between water and the food source.

How often?

# Portable Buildings

---



Written Procedures and a lot of communication. Our most common problem in portables is someone setting the thermostat to fan or on. This bring in outside air without removing moisture. In our Houston area, it takes one day to have mold growth in these conditions.

# Summer Humidity in Portable Buildings

---



I call this “people grease”. As you can see it is a great food source. Special attention to cleaning can avoid this problem. The rate and amount of mold growth is a combination of the amount of water (or percentage of humidity in this case) and the type of food source.

# Cafeteria Tables

---



This is left over food and people grease growing mold in the summer.

# Not Mud but Mold!

---



Our maintenance and operations folks know to never put a walk off mat where there is water and carpet. It causes serious mold growth and odors.

# Occupant Behavior

---



This particular water event spurred a surge of guidelines about facility use. A teacher firing a kiln over the weekend without knowing that the ventilation was not working caused a wing of classrooms and a wooden stage to flood from the fire sprinkler.

Guidelines from Area Supervisors about facility use.



# Water Extraction

---



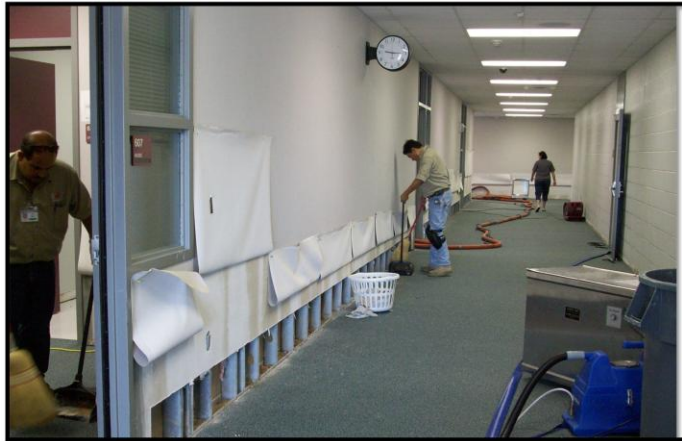
We removed the damaged sheetrock, cleaned and dried the wall track.

# Drying Equipment



Katy ISD has a fantastic maintenance and operations team. They removed the front of this wood stage and began to dry it out. We have our own drying equipment, but we also have local vendors who are always ready to rent or assist.

Send us all you have



This is a picture of what the work looked like in progress.

# Cost Savings

- Improve student attendance
- Lower risk mitigation costs
- Prolong the building life
- Reduced Pest Management costs



It cost less to be proactive then reactive.

Cleaning is the first defense for a healthy environment. The building envelop, design and material used for construction are also important components of a healthy school. The EPA Tools for Schools program offers excellent guidance including mold remediation in schools.

## **KEY DRIVER:**

**Act to Address Structural, Institutional and Behavioral Issues**

# ACT

- Educate Staff About IAQ to Change Behavior
- Train Occupants to Address IAQ Risks
- Address the Source of Problems

All of our facilities are scheduled for annual IEQ walk-thru inspections. Locations, such as the pods we looked at, have scheduled inspections. Planning has to occur to have a preventive maintenance program.

After planning, Act to address structural, institutional, and behavioral concerns.

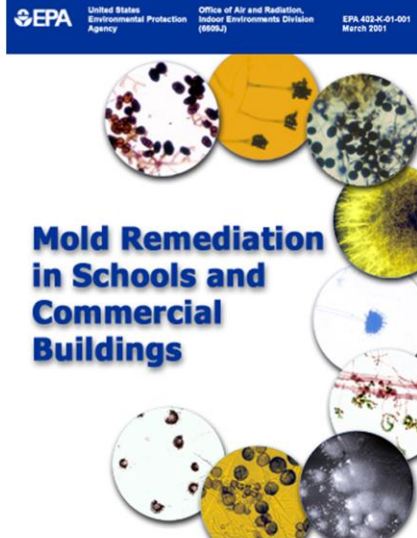
[illegible]

# Guidance Materials

- Non-regulatory guidance.
- Aimed at building managers, professional remediators, anyone dealing with mold issues.
- Mold prevention and remediation.
- Checklists and resources.
- Suggestions on how to communicate with building occupants about IAQ.



[www.epa.gov/mold](http://www.epa.gov/mold)



Indoor Air Quality (IAQ)

## ***IAQ Tools for Schools Resources***

- *IAQ Tools for Schools* Connector e-Newsletters and Emails:
  - Send an email to: [IAQTfSConnector@cadmusgroup.com](mailto:IAQTfSConnector@cadmusgroup.com)
  - View archives at: <http://www.epa.gov/iaq/schools/bulletins.html>
- Schools IAQ Connector Email Discussion List:
  - Send a blank e-mail message to [schools\\_iaq\\_connector\\_subscribe@lists.epa.gov](mailto:schools_iaq_connector_subscribe@lists.epa.gov). Then, check your email inbox for your confirmation and membership details.
- *IAQ Tools for Schools* Website
  - Action Kit: <http://www.epa.gov/iaq/schools/actionkit.html>
  - Framework: <http://www.epa.gov/iaq/schools/excellence.html>





# Questions and Answers

**Please use the questions/chat pane on your webinar console to send us your questions.**



Indoor Air Quality (IAQ)